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अनुक्रमांक Roll No. _____	
पाठ्यक्रम Course _____	
दिनांक Date _____	
	अनुदेशक का अध्याक्षर Instructor Initial

Study of Primary digital Multiplexing equipment (MAKE Webfil flexi MUX)

OBJECTIVE: After completion of this experiment, trainees are able to identify the cards and understand their functionality, pin configuration and also the wiring from cards to terminations (KRONE), practices setting up of MUX-ID through DIP switch.

Description: The Flexi MUX is a programmable Drop/Insert multiplexing equipment which combines a variety of voice and data traffic into a 2 .048 Mbps stream. It is a compact unit based on the 19" mechanical construction measuring 10.5" H (6U) x 19" W x 19" D (267mm x 483mm x 457mm). This 6U sub rack is a common mechanical housing with a bussed backplane which accepts all the modules with vertical mounting making a modular equipment concept possible. LEDs on the front panel indicate the status of all the individual modules.

The basic system consists of :

- Sub-Rack with the back plane.
- Power supply Module.
- The Network Interface Module.
- Tributary Module.
- Voice access/data access module

a) SUB-RACK: The sub-rack has altogether 13 slots for housing the various modules. Out of these slot-1 and slot-2 are dedicated for PSU modules (in case of redundant power supply) and slot-3 and slot-4 are dedicated for the Network interface Module (NIM) and Tributary Module (TM) respectively. Slot-5 to slot-13 are meant for housing various access modules for both voice and data interface. Each of these slots supports access to 4 time slots of the 2 Mbps stream. Thus slot-5 to slot-11 supports altogether 28 time slots of the 2 Mbps bus. Slot-12 and slot-13 has equal and parallel access to time slots 30 and 31. This has been done for efficient utilization of the bit stream during sub-multiplexing of a time slot for low speed data. The structure of the sub-rack and time slot allocation is shown in figure below.

PSU	PSU	NIM	TM	ACCESS MODULE TS1 - TS4	ACCESS MODULE TS5 - TS8	ACCESS MODULE TS9 - TS12	ACCESS MODULE TS13 - TS15 & TS17	ACCESS MODULE TS18 - TS21	ACCESS MODULE TS22 - TS25	ACCESS MODULE TS26 - TS29	ACCESS MODULE TS30 & T31	ACCESS MODULE TS30 & T31
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sub-rack slots and respective module positions

Access to the 2 Mb ports are available from the backplane from the rear side. Separate connectors are available for 75Ω and 120Ω impedance matching. For 75Ω, spinner type

threaded connector has been provided for firm contact. For 120Ω, three pin 1mm square post has been provided for either wire wrap termination or termination through self lock header socket. A separate port is also available for driving the system using external clock. Extension of voice and data has been provided on Euro type wire wrap connectors. This has enough space for wrapping 0.5mm or 0.6mm telephone cable normally used for telecommunication. Separate connector has been provided feeding input -48V DC power supply to FlexiMUX. The backplane also provided a D-Shell 9pin connector for interfacing the V-24 / RS232C serial link of the Network Monitoring System. NMS can also be accessed from RJ11 jack located at the front of NIM.

b)The power supply Module: operates from 48V supply. The input power is fed through a surge protector and filter section to protect the system from high voltage spikes and lightning strikes coming along the power line. The first stage is a Gas Arrestor which can absorb high energy pulses. This is followed by LC filter which then faces a transient protector to bring down the spikes within acceptable limit. The primary supply is connected to earth through high voltage capacitors to bypass AC noises but ensuring DC isolation.

Each PSU has three separate switching power supply modules, one for +5V, one for ±10V and another for +80V. They are also mutually isolated with each other. +5V is used to operate all the digital devices of the system. The card also has under-voltage and overvoltage alarm for both input and output. The capacity of the PSUs is overrated adequately so that each of the PSUs individually can support the whole system.

The power supply is rated as follows:

- +5V - 2.50 Amp
- ±10V - 0.75 Amp
- +80V - 0.05 Amp

For a typical configuration with 4 E&M, 4 Exch, 4 Subs/Hotline and 2 G.703 data, the typical power consumption is 48 watts. The output voltages, adjustments can be done through the following potentiometers.

Voltage	Pots	Range
5V	R20	4.57V – 5.6V
±10V	R41	9.20V – 11.
80V	R67	70V – 100V

c) NETWORK INTERFACE MODULE (NIM):

The Network Interface Module primarily takes care of the alarm acquisition function from various internal and external sources and responds to the queries and commands issued by the Network Manager through the “Super- Net” Network Management System. The module runs on a high performance Intel 80C196 microcontroller with associated communication and alarm interfaces for its operation. The Network Interface module is used for exchange of information among the Network Manager, the Tributary Module and the various access modules interconnected via the backplane. It has altogether four communication interfaces for information exchange. The network management system is realized through two serial interfaces, one for external NMS for interfacing the central supervisory computer while the other is used for realizing the NMS through the unused National bits of the 2 Mb stream. Other than these, the tributary unit is interconnected through a serial link while the access modules are interfaced through another serial bus.

Switch Setting of Network Interface Module: Switch–S2 (To make the equipment as master/slave)

Switch Position	Switch Position	Remarks
1	OFF	NA
	ON	NA
2	OFF	NA
	ON	NA
3	OFF	Master

4	ON	Slave
	OFF	External
	ON	Internal NMS

Setting the station address switches (S4&S5): These switches are used to give the system a specified and unique address number for NMS. Upto 99 station addresses can be given through rotary switches, each of which has settings from 0 through 9 and A through E to allow alpha numeric or hexa decimal settings.

d) TRIBUTARY MODULE

The Tributary Module interfaces to the 2 Mbps stream and realises the add-drop function of the channel through digital cross-connect.

The function of the Tributary Module is to:

- Extract the master clock (MCLK) of the Network from the incoming 2 Mbps streams.
- Synchronize the phase of the incoming frame of the incoming 2 Mbps streams and also that of the internal 2 Mb bus for local access.
- Cross-connect 64 Kbps digital data along with signaling data.
- Perform PCM summing of conference channels along with logical summing of corresponding signaling data.
- Generate 2 Mbps internal TDM bus for channel units.
- Generate 2 Mbps HDB-3 encoded interface signals.
- Collect and analyze equipment and line faults and take necessary actions.
- Control jitter to a limit well below the limit.
- Report to Network Interface Module about the alarm status of the 2 Mb stream and the module.
- Support a communication channel through the use of National bits of TS0 for Network Monitoring and Control.

2 Mb/s Line Interface Unit: Is an integral part of Tributary module where it accepts two 2 Mbps HDB-3 signal (G.703) from two directions in G.732 format and the third 2 Mbps NRZ signal from PCM channel port. The unit also monitors the line condition and errors of the incoming stream and reports to the main processor unit for necessary actions. Both the incoming and outgoing streams are coupled through isolation transformers. Strap option has been provided to select line impedance of 75Ω unbalanced or 120Ω balanced interface.

Switch Setting of Tributary Card:

Switch Position	Status	Remarks
1	OFF	Normal Mode
	ON	CRC4 Mode
2	OFF	Normal End Terminal
	ON	End Terminal with protection
3	OFF	Trib-A set as Master
	ON	Trib-B set as Master
4	OFF	Transmit remote alarm to other end
	ON	Stop transmitting remote alarm to other end
5	OFF	Terminal set to D/I mode
	ON	Terminal set to End Terminal mode
6	OFF	Terminal operate in extracted clock
	ON	Terminal operate in internal clock
7	OFF	2Mb/s port set to 75Ω impedance
	ON	2Mb/s port set to 120Ω impedance
8	OFF	Remote table switching disabled
	ON	Remote table switching enabled

e) Voice Access Module: Each access module accommodates four channels per card. The modules can be plugged into any one of the physical slots (from slot 4 – slot 12) of the subrack for extending the connection to the subscriber equipment.

The following standard interfaces are supported by the Voice Access Module.

- i. 2W/4W E&M Interface
- ii. Subscriber Interface
- iii. Exchange Interface
- iv. Hot Line Interface

To enhance the flexibility of the type of access, the various interfaces are provided by small plug-in modules which are fitted to any one of the four adaptor sockets of the voice module. This flexible feature provides maximum utilisation of channel access without sacrificing any time slot.

i. 2W/4W E&M Interface

For 4W interface circuit, the voice is extended through a pair of balance line for both transmit and receive. Separate line transformers are used for this purpose. The impedance is matched for 600 ohms.

Signaling is provided by separate E and M leads. M lead provides the incoming signaling which is sensed by an opto-isolator. The user's equipment normally extends earth or no earth which is sensed by the opto-isolator against the primary -48V. E-lead provides the outgoing signaling and it extends earth or no-earth through a transistor acting as a solid-state switch.

ii. Subscriber Interface

This interface is normally used for extending a voice to the plain old telephone sets (POTS). In this interface both the signaling and voice is sent over one pair of wire. The unit provides talk current from the primary -48V source for the operation of the telephone set. Hook condition and dial pulses are sent by interrupting the loop current in the handset. The interface also has built-in ringer to buzz the phone for incoming calls. The subscriber interface along with the exchange interface described below can be used for extending the subscribers of a local exchange to remote sites through the FlexiMUX.

iii. Exchange Interface

This interface is used for interfacing the exchange side of a subscriber line. Depending on the hook status of the subscriber, the exchange interface extends loop to the exchange. It basically emulates the function of the telephone to the exchange and reproduces the voice and signaling of the telephone set. It also senses the ring and loop reversal condition which is sent to the subscriber interface for reproduction.

iv. Hotline Interface

This is basically subscriber to subscriber interface. Depending on the off-hook status at one end, the ringer is activated at the other end. The ringer is automatically deactivated as soon as the handset is lifted. After the conversation is over, both the user will have to come back to the on-hook condition to enable the ring again.

f) 64 KB/S DATA INTERFACE (G.703)

One 64 Kb/s data card caters for two 64 Kb/s codirectional data channel which conforms to ITU-T G703 requirement. Each channel consists of a general purpose line interface chip (XR-T6164). It contains both transmit and receive circuitry to interface TTL signal either from or to a twisted pair cable. In conjunction with the XR-T6164, the XR-T6165 will form a ITU-T G.703 compatible 64 Kb/s data adaption unit, interfacing between 2048 Kb/s PCM highway and a variable length twisted pair cable.

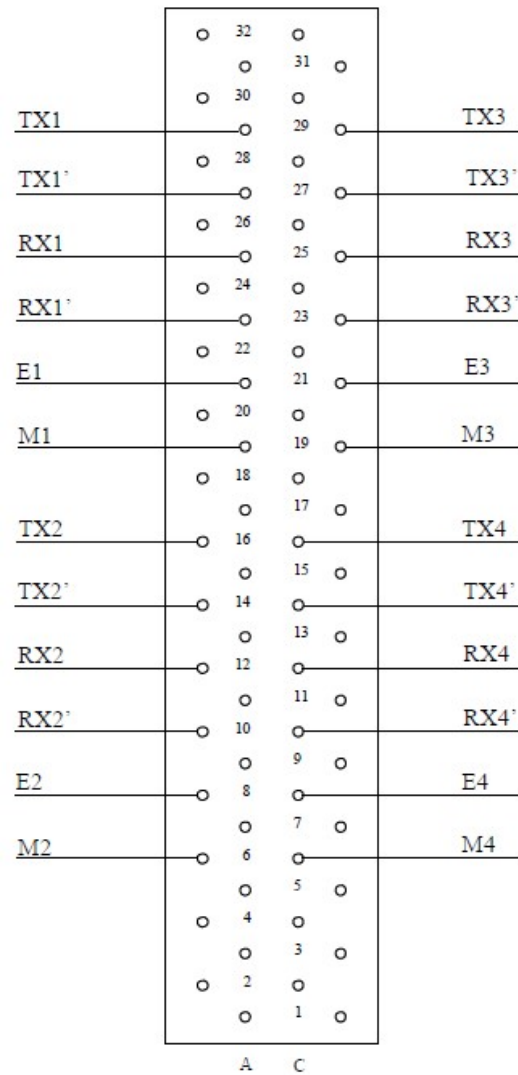


Fig.2.Pin details on wire wrappable connector for voice&G703 data interface

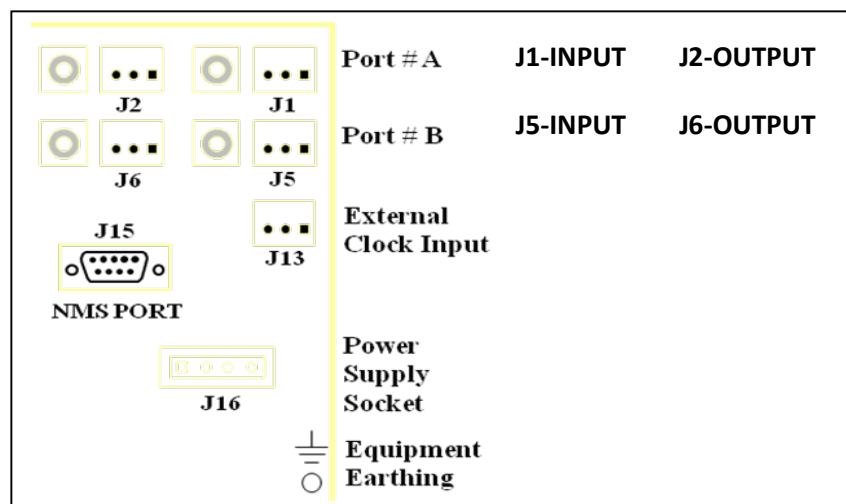


Fig.3.2MB, External clock, power supply interfaces on back plane Back plane

Review Questions

1. Identify the various modules equipped in the equipment and draw a diagram showing the slots and cards present in the slots.
2. Draw a neat wiring diagram showing the connections between the Krone and the Wire Wrap connectors of the system for each channel.

Signature of the candidate